PATENT ABSTRACTS OF JAPAN

(11)Publication number : **06-105568**

(43)Date of publication of application : **15.04.1994**

(51)Int.CI. H02N 2/00
B23Q 5/28
B25J 19/00
G05D 3/00
H01L 41/09

(21)Application number : **04-253246**

(22)Date of filing : **22.09.1992**

(71)Applicant : **SHIMADZU CORP**

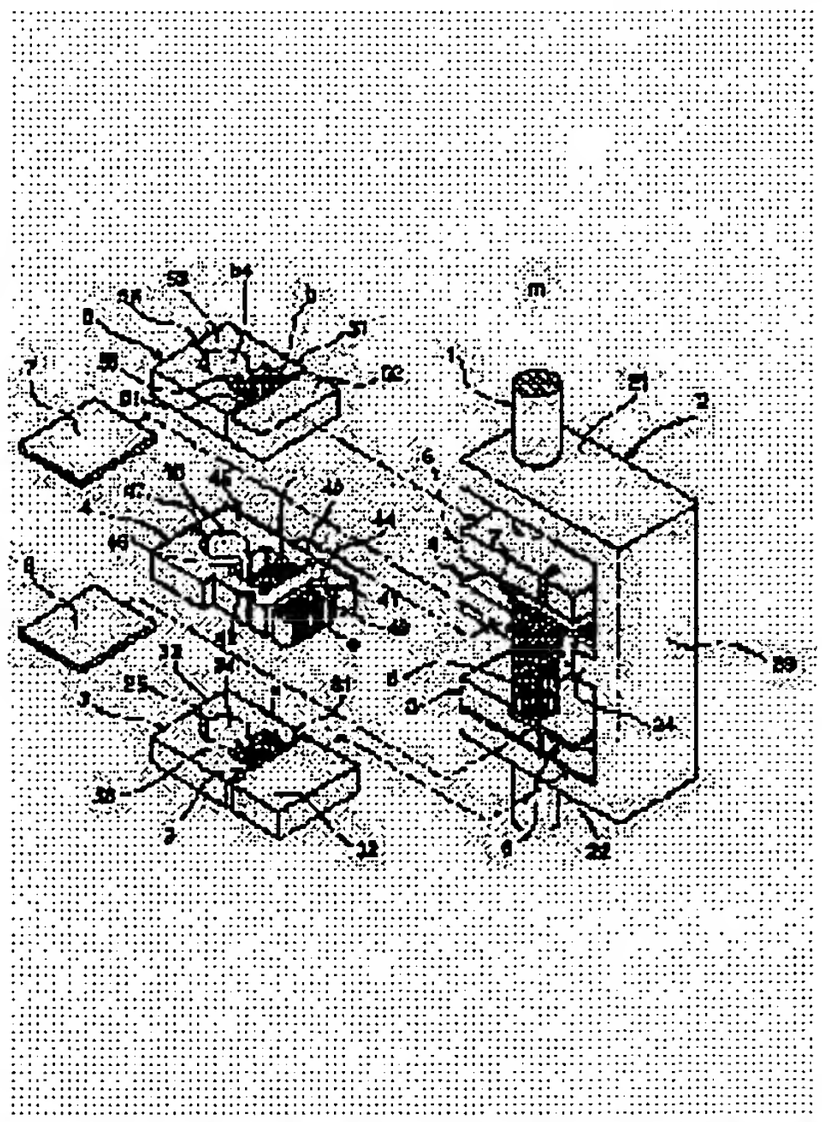
(72)Inventor : **OTA YASUYOSHI**

(54) INCHING WORM

(57)Abstract:

PURPOSE: To improve positioning accuracy as compared with a conventional rotary actuator and to reduce in size and weight by realizing a rotary inching worm.

CONSTITUTION: An arm 1 of an operating lever is inserted into a stator 3 and a rotor 4, and the arm 1 is gripped with/released from the elements 3, 4 through piezoelectric elements (a), (c). A piezoelectric element (e) for energizing the rotor 4 to normally/reversely drive the stator 3 around an axial center (m) of the arm 1 is provided. These elements (a), (c), (e) are pulse-driven by a common driver.



LEGAL STATUS

[Date of request for examination] 25.03.1994

[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	2536370
[Date of registration]	08.07.1996
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	08.07.1999

CLAIMS

[Claim(s)]
[Claim 1] The stator by which the hole which can expand and contract to the abbreviation radial was inserted in the actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., The actuator element for stators which carries out expanding-and-contracting actuation of the stator hole, and the rotator by which the hole which can expand and contract to the abbreviation radial was inserted in said actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., It comes to provide the actuator element for rotators which carries out expanding-and-contracting actuation of the rotator hole, and the actuator element for rotation which is prepared in the part which biased from said rotator hole, makes said stator a footing and energizes this rotator to the circumference of the axial center of an actuation lever. The inch worm characterized by constituting so that revolution actuation of the actuation lever can be carried out at the shape of a pulse by driving said each actuator element, and repeating and giving minute rotation of the forward direction or hard flow to said stator to said rotator.
[Claim 2] The stator by which the hole which can expand and contract to the abbreviation radial was inserted in the actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., With the actuator element for stators which carries out expanding-and-contracting actuation of the stator hole, and the migration child by whom the hole which can expand and contract to the abbreviation radial was inserted in said actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. It comes to provide the actuator element for migration children which carries out expanding-and-contracting actuation of the migration larval tunnel, and the actuator element for migration which makes said stator a footing and energizes said migration child in the direction of an axial center of an actuation lever. The inch worm characterized by constituting so that attitude actuation of the actuation lever can be carried out at the shape of a pulse by driving said each actuator element, and repeating and giving said migration child the minute rectilinear motion of the forward direction over said stator, or hard flow.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] The inch worm concerning this invention realizes revolution actuation of an actuation lever through those pulse actuation using actuator elements, such as a piezoelectric device, as explained above. Since it is, and positioning also with exact opening control can be performed, the lock device in which it is [making holding power act on an actuation lever from those actuator elements] easy at the time of a halt it, and it is special can be made unnecessary and the configuration as [whole] an actuator can also use a comparatively small and lightweight thing for each actuator element itself, small and lightweight-ization can be achieved compared with the conventional rotary actuator, and the unloading to an actuation lever can be achieved. The above effectiveness is the same also in a linear mold. Moreover, an above-mentioned revolution mold and an above-mentioned linear mold are merged, and when it constitutes so that actuation of both sides may be realized by the single inch worm, a stator, the actuator element for stators, and since a driver can also be shared further, the effectiveness which promotes further the effectiveness of the unloading to whole miniaturization and a whole actuation lever compared with the case where the actuator of another ** is constituted from a revolution form and a linear form is acquired.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The decomposition perspective view showing one example of this invention.
[Drawing 2] The front view of this example.
[Drawing 3] III-III in drawing 2 Line sectional view.
[Drawing 4] IV-IV in drawing 2 Line sectional view.
[Drawing 5] V-V in drawing 2 Line sectional view.
[Drawing 6] The operation explanatory view of the piezoelectric devices a, b, and c in this example.
[Drawing 7] The operation explanatory view corresponding to drawing 6 .
[Drawing 8] Chart drawing showing the outline of the control when carrying out normal rotation actuation of the arm in this example.
[Drawing 9] Chart drawing showing the outline of the control when carrying out inversion actuation of the arm in this example.
[Drawing 10] The front view showing the stator when carrying out revolution actuation of the arm in this example, and the situation of a rotator omitted in part.
[Drawing 11] The bottom view corresponding to drawing 4 which shows the situation of the rotator when carrying out revolution actuation of the arm in this example.
[Drawing 12] The operation explanatory view corresponding to drawing 10 .
[Drawing 13] The operation explanatory view corresponding to drawing 11 .
[Drawing 14] The operation explanatory view corresponding to drawing 10 .
[Drawing 15] The operation explanatory view corresponding to drawing 11 .
[Drawing 16] The operation explanatory view corresponding to drawing 10 .
[Drawing 17] The operation explanatory view corresponding to drawing 11 .
[Drawing 18] Chart drawing showing the outline of the control when carrying out linear actuation of the arm in the forward direction in this example.
[Drawing 19] Chart drawing showing the outline of the control when carrying out linear actuation of the arm to hard flow in this example.
[Drawing 20] Drawing showing the whole situation when carrying out linear actuation of the arm in this example.
[Drawing 21] The operation explanatory view corresponding to drawing 20 .
[Drawing 22] The operation explanatory view corresponding to drawing 20 .
[Drawing 23] The operation explanatory view corresponding to drawing 20 .
[Description of Notations]
1 -- Actuation lever (arm)
3 -- Stator
4 -- Rotator
5 -- Migration child

34 -- Stator hole
46 -- Hole for rotators
54 -- Migration larval tunnel
a -- Actuator element for stators (piezoelectric device)
b -- Actuator element for migration children (piezoelectric device)
c -- Actuator element for rotators (piezoelectric device)
d -- Actuator element for migration (piezoelectric device)
e -- Actuator element for a revolution (piezoelectric device)

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is included in a robot, a manipulator, a table, etc., and relates to an inch worm available as an actuator.
[0002]
[Description of the Prior Art] Many actuators are built into the robot or the manipulator. A deer is carried out and, generally the linear mold and the revolution mold are known for a motor type, electromagnetic, an ultrasonic type, etc. by the conventional actuator.
[0003]
[Problem(s) to be Solved by the Invention] However, those actuators have the respectively following faults. First, if it is in the motor type represented by AC and a DC motor, and the step motor, in order that AC and a DC motor may obtain the revolution of a high resolution, it has the fault which needs a reducer and cannot perform positioning of high degree of accuracy by the backlash, and when you are trying for a step motor to obtain the revolution of a high resolution by micro step actuation, it has the fault which must always be energized at the time of a halt. On the other hand, if it is in electromagnetic or an ultrasonic type, in order to position high degree of accuracy, it is necessary to feed back by attaching an encoder, and has the fault to which a device and control become complicated.
[0004] On the other hand, the thing of the inch worm type using a piezoelectric device is considered recently. According to the inch worm type, the effectiveness whose configuration exact positioning can also perform opening control since a piezoelectric device is driven for every pulse, can make a special lock device unnecessary since a piezoelectric device makes holding power act on a driven object at the time of a halt, and is also possible for a compact is expectable. A revolution mold has still come [however, / what existing is only a linear mold, and the structure is also comparatively complicated, and] to be developed. In order to give actuation of the both sides of rectilinear motion and rotation to a robot's arm etc. in moreover and the former, even if it can use the above-mentioned inch worm type for a linear mold, in a revolution mold, a colander is not obtain using a past motor type, electromagnetic, or ultrasonic-type actuator, but since the classes of actuator besides the fault which the actuator has differ, the new nonconformity that two kinds of drivers are needed arises.
[0005] This invention is made in view of such the actual condition, develops the revolution mold inch worm and cover-half inch worm of comparatively easy structure, and aims at solving the nonconformity of description at once based on it.
[0006]
[Means for Solving the Problem] The following configurations are used for this invention in order to attain this object.
[0007] Namely, the stator by which, as for the inch worm concerning this invention, the hole which can expand and contract to the abbreviation radial was first inserted in the actuation lever by the hole of

owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. as a revolution mold, The actuator element for stators which carries out expanding-and-contracting actuation of the stator hole, and the rotator by which the hole which can expand and contract to the abbreviation radial was inserted in said actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., It comes to provide the actuator element for rotators which carries out expanding-and-contracting actuation of the rotator hole, and the actuator element for rotation which is prepared in the part which biased from said rotator hole, makes said stator a footing and energizes this rotator to the circumference of the axial center of an actuation lever. By driving said each actuator element, and repeating and giving minute rotation of the forward direction or hard flow to said stator to said rotator, it is characterized by constituting so that revolution actuation of the actuation lever can be carried out at the shape of a pulse.

[0008] Moreover, the stator by which the hole which can expand and contract to the abbreviation radial was inserted in the actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. as a linear mold, With the actuator element for stators which carries out expanding-and-contracting actuation of the stator hole, and the migration child by whom the hole which can expand and contract to the abbreviation radial was inserted in said actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. It comes to provide the actuator element for migration children which carries out expanding-and-contracting actuation of the migration larval tunnel, and the actuator element for migration which makes said stator a footing and energizes said migration child in the direction of an axial center of an actuation lever. By driving said each actuator element, and repeating and giving said migration child the minute rectilinear motion of the forward direction over said stator, or hard flow, it is characterized by constituting so that attitude actuation of the actuation lever can be carried out at the shape of a pulse.

[0009]

[Function] Along with the 1 control mode of a control means, a fundamental operation of invention concerning claim 1 is divided into six steps of step 1 - step 6, and is explained. First, by the initial state, make the diameter of a stator hole reduce through the actuator for stators, the diameter of a rotator hole is made to reduce through the actuator for rotators, and the actuator for rotation is degenerated. In this condition, an actuation lever is gripped in a stator and a rotator. Next, the diameter of a stator hole is made to expand through the actuator element for stators at step 1. By this, an actuation lever is opened from a stator and will be gripped only in a rotator. And the actuator element for a revolution is expanded at step 2, and forward revolution energization of the rotator is carried out at the circumference of an axial center. Thereby, a rotator rotates only a predetermined include angle and only the same include angle also rotates the actuation lever gripped in the rotator at this time. Then, while making the diameter of a stator hole reduce through the actuator element for stators at step 3, the diameter of a rotator hole is made to expand through the actuator element for rotators at step 4. Thereby, an actuation lever is opened from a rotator and grips only in a stator. From the condition, the actuator element for a revolution is degenerated at step 5, and counterrotation energization of the rotator is carried out at the circumference of an axial center. Thereby, while the actuation lever had been held in the location, only a rotator carries out counterrotation only of the predetermined include angle, and it returns to the original location. And the diameter of a rotator hole is made to reduce through the actuator element for rotators at step 6 finally, and it returns to the initial state stated to the beginning. By repeating the above actuation, forward revolution actuation of the actuation lever will be carried out at the shape of a pulse. Moreover, if such control is carried out to reverse, counterrotation actuation of an actuation lever will be realized.

[0010] On the other hand, along with the 1 control mode of a control means, an operation of invention concerning claim 2 is divided into six steps of step 1 - step 6, and is explained. First, by the initial state, make the diameter of a stator hole reduce through the actuator for stators, the diameter of a migration

larval tunnel is made to reduce through the actuator for migration children, and the actuator for migration is degenerated. In this condition, an actuation lever is gripped to a stator and a migration child. Next, the diameter of a stator hole is made to expand through the actuator element for stators at step 1. By this, an actuation lever is opened from a stator and will be gripped only to a migration child. And the actuator element for migration is expanded at step 2, and advance energization of the migration child is carried out in the direction of an axial center. Thereby, a migration child moves forward and only a predetermined stroke also moves the actuation lever gripped to the migration child at this time only for the same stroke. Then, while making the diameter of a stator hole reduce through the actuator element for stators at step 3, the diameter of a migration larval tunnel is made to expand through the actuator element for migration children at step 4. Thereby, an actuation lever is opened from a migration child and grips only in a stator. From the condition, the actuator element for migration is degenerated at step 5, and retreat energization of the migration child is carried out in the direction of an axial center. Thereby, while the actuation lever had been held in the location, only a migration child moves only a predetermined stroke and it returns to the original location. And the diameter of a migration larval tunnel is made to reduce through the actuator element for migration children at step 6 finally, and it returns to the initial state stated to the beginning. By repeating the above actuation, advance actuation of the actuation lever will be carried out at the shape of a pulse. Moreover, if such control is carried out to reverse, retreat actuation of an actuation lever will be realized.

[0011]

[Example] Hereafter, the example of this invention is explained with reference to a drawing.

[0012] this inch worm is shown in drawing 1 -- as -- a guide 2 -- a stator 3 and the actuator for stators -- an element -- a piezoelectric device a, a rotator 4, and the actuator for rotators -- an element -- a piezoelectric device c and the object for a revolution -- an actuator -- a piezoelectric device e, the migration child 5, and the actuator for migration children -- an element -- a piezoelectric device b and a list -- the actuator for migration -- an element -- a piezoelectric device d -- incorporating -- those proper locations -- actuation -- a lever -- it comes to insert in the shaft-like arm 1

[0013] A guide 2 makes the side view KO typeface which consists of the top plating section 21, the bottom plate section 22, and the side plate section 23, and said arm 1 is inserted in the top plating section 21 and the bottom plate section 22, respectively. The protruding piece 24 protrudes in the center of a side edge of the side plate section 23.

[0014] The end face section 32 and the point 33 which were connected by the hinge region 31 as a stator 3 was shown in drawing 1 - drawing 3 , The stator hole 34 for axial insertion drilled in the center of the point 33 in the thick direction, It is the thing which comes to provide the rectangle hole 36 drilled between the infeed 35 which divides a point 33 right and left and opens the stator hole 34 to a head side, and said stator hole 34 and said hinge region 31. Where said piezoelectric device a is included in the rectangle hole 36, the end face section 32 is fixed to the inner circumference of a guide 2, and the arm 1 is made to insert in the stator hole 34. PZT (trademark) is used for this piezoelectric device a, and that actuation direction is set up in the direction which uses said hinge region 31 as the supporting point, and pushes a point 33 open right and left as shown in drawing 6 and drawing 7 . That is, when applied voltage is L level, while degenerating in the location shown in drawing 6 , making the diameter of the stator hole 34 reduce and making the stator hole 34 grip an arm 1 as a result, when applied voltage is H level, elongate to the location shown in drawing 7 , the diameter of the stator hole 34 is made to expand, and an arm 1 is released from the stator hole 34.

[0015] The end face section 43, the pars intermedia 44, and point 45 which were connected by hinge regions 41 and 42 as a rotator 4 was shown in drawing 1 , drawing 2 , and drawing 4 , The rotator hole 46 for axial insertion drilled in the center of the point 45 in the thick direction, It is the thing which comes to provide the rectangle hole 48 drilled between the infeed 47 which divides a point 45 right and

left and opens the stator hole 46 to a head side, and said rotator hole 46 and said hinge region 42. While including said piezoelectric device c in the rectangle hole 48, the end of a piezoelectric device e is fixed in the end face section 43. And the other end of a piezoelectric device e is fixed to the protruding piece 24 of a guide 2, and the arm 1 is made to insert in the rotator hole 46 in the condition. Piezoelectric devices c and e are PZT(s). Actuation of a piezoelectric device c Diameter reduction actuation (diameter expansion actuation) (release actuation) of the rotator hole 46, i.e., the grip actuation to an arm 1, is made to accompany, as it degenerates when applied voltage is L level (H level) (expanding), and a hinge region 42 is used as the supporting point and it is shown in drawing 6 (drawing 7). When applied voltage is L level (H level), actuation of a piezoelectric device e holds the end face 43 of a rotator 4 in a criteria location (revolution location), as it is made a footing, it degenerates in the vertical direction to the axial center m of an arm 1 (expanding) and a protruding piece 24 is shown in drawing 11 (drawing 13). In addition, when this piezoelectric device e operates, while a hinge region 41 deforms, distortion of the joining segment of the end face section 43 and pars intermedia 44 is absorbed.

[0016] The end face section 52 and the point 53 which were connected by the hinge region 51 as the migration child 5 showed drawing 1 , drawing 2 , and drawing 5 , The migration larval tunnel 54 for axial insertion drilled in the center of the point 53 in the thick direction, It is the thing which comes to provide the rectangle hole 56 drilled between the infeed 55 which divides a point 53 right and left and opens the stator hole 54 to a head side, and said migration larval tunnel 54 and said hinge region 51. Where a piezoelectric device b is included in the rectangle hole 56, while making an arm 1 insert in the migration larval tunnel 54, the piezoelectric device d is inserted between the fields where the migration child 5 and said stator 3 counter mutually. Piezoelectric devices b and d are PZT(s). Actuation of a piezoelectric device b Diameter reduction actuation (diameter expansion actuation) (release actuation) of the migration larval tunnel 54, i.e., the grip actuation to an arm 1, is made to accompany, as it degenerates when applied voltage is L level (H level) (expanding), and a hinge region 51 is used as the supporting point and it is shown in drawing 6 (drawing 7). When applied voltage is L level (H level), actuation of a piezoelectric device d holds the migration child 5 in a criteria location (stroke location), as a stator 3 is made into a footing, it degenerates in the direction of axial center m of an arm 1 (expanding) and it is shown in drawing 20 (drawing 21).

[0017] In addition, 6 and 7 are the plates for equipping with a piezoelectric device d, respectively, and one plate 6 fixed the part which is installed in the field of said stator 3 and does not bar actuation of the point 33, and has fixed the part which the plate 7 of another side is installed in said migration child's 5 field, and does not bar actuation of the point 53.

[0018] In here, drawing 8 shows the outline of the control at the time of carrying out revolution actuation of the inch worm by the timing diagram, and drawing 10 - drawing 17 omit the situation of actuation of the rotator 4 in that case, and show the migration child 5. Hereafter, actuation of this example is explained along these drawings.

[0019] First, if drawing 8 is seen, this control consists of six steps. In the initial state, all applied voltage of each actuator a-e is made into L level (or energizing [no]), and piezoelectric devices a, c, and b make the diameter of the stator hole 34, the rotator hole 46, and the migration larval tunnel 54 reduce, respectively, those holes 34, 46, and 54 are made to grip an arm 1, and a piezoelectric device d holds the migration child 5 in a criteria location, and, as for a piezoelectric device e, holds the rotator 4 in the criteria location. Next, make applied voltage of piezoelectric devices a and b into H level at step 1, the diameter of the stator hole 34 and the migration larval tunnel 54 is made to expand, and an arm 1 is released. An arm 1 will be gripped only in a rotator 4 by this (drawing 10 and drawing 11). And applied voltage of a piezoelectric device e is made into H level at step 2. Thereby, a rotator 4 drives to a revolution location to the circumference of the axial center m of an arm 1, and only the same include angle also rotates the arm 1 gripped in the rotator 4 at this time (drawing 12 and drawing 13). Then,

while step 3 drops the applied voltage of a piezoelectric device a on L level, applied voltage of a piezoelectric device c is made into H level at step 4. An arm 1 will be gripped only in a stator 3 by this (drawing 14 and drawing 15). And step 5 drops the applied voltage of a piezoelectric device e on L level, and counterrotation of the rotator 4 is carried out to the circumference of an axial center m to a criteria location (drawing 16 and drawing 17). At this time, since the arm 1 is gripped only in the stator 3, it is immobilization. And finally step 6 drops the applied voltage of a piezoelectric device c on L level, and all piezoelectric devices a other than a piezoelectric device b and the impression condition of c-e are returned to an initial state. Since piezoelectric devices b and d are objects for linear actuation mentioned later, they are always held at H level or L level so that revolution actuation may not be barred here. When it means that X point on the arm 1 which was in the location of drawing 11 in 1 cycle of steps 1-6 as mentioned above had moved to the location of drawing 17 and it repeats such a cycle, it becomes possible to carry out revolution actuation of the arm 1 at the shape of a pulse. Drawing 9 is making bilateral symmetry mostly with the chart of drawing 8 , and can realize counterrotation actuation of an arm 1 by controlling piezoelectric-device a-e along with this chart.
[0020] On the other hand, drawing 18 shows the outline of the control at the time of carrying out linear actuation of the inch worm by the timing diagram, and drawing 20 - drawing 23 omit the situation of actuation of the migration child 5 in that case, and show the rotator 4.
[0021] First, if drawing 18 is seen, this control also consists of six steps. In the initial state, all applied voltage of each actuator a-e is made into L level (or energizing [no]), and piezoelectric devices a, c, and b make the diameter of the stator hole 34, the rotator hole 46, and the migration larval tunnel 54 redúce, respectively, those holes 34, 46, and 54 are made to grip an arm 1, and a piezoelectric device d holds the migration child 5 in a criteria location, and, as for a piezoelectric device e, holds the rotator 4 in the criteria location. Next, make applied voltage of piezoelectric devices a and c into H level at step 1, the diameter of the stator hole 34 and the rotator hole 46 is made to expand, and an arm 1 is released. An arm 1 will be gripped only to the migration child 5 by this (drawing 20). And applied voltage of a piezoelectric device d is made into H level at step 2. Thereby, the migration child 5 is energized to a predetermined stroke location in the direction of axial center m of an arm 1, and only the same stroke also moves the arm 1 gripped to the migration child 5 at this time (drawing 21). Then, while step 3 drops the applied voltage of a piezoelectric device a on L level, applied voltage of a piezoelectric device b is made into H level at step 4. An arm 1 will be gripped only in a stator 3 by this (drawing 22). And step 5 drops the applied voltage of a piezoelectric device d on L level, and the reverse stroke of the migration child 5 is carried out to a criteria location along with an axial center m (drawing 23). At this time, since the arm 1 is gripped only in the stator 3, it is immobilization. And finally step 6 drops the applied voltage of a piezoelectric device b on L level, and the impression condition of all piezoelectric devices a, b, d, and e other than a piezoelectric device c is returned to an initial state. Since piezoelectric devices c and e are the objects for revolution actuation mentioned above, they are always held at H level or L level so that linear actuation may not be barred here. When it means that Y on the arm 1 which was in the location of drawing 20 in 1 cycle of steps 1-6 as mentioned above had moved to the location of drawing 23 and they repeat such a cycle, it becomes possible to carry out linear actuation of the arm 1 at the shape of a pulse. Drawing 19 is making bilateral symmetry mostly with the chart of drawing 18 , and can realize linear actuation of the hard flow of an arm 1 by controlling piezoelectric-device a-e along with this chart.
[0022] Only piezoelectric-device a-e is used for a graphic display inch worm as an actuator element as mentioned above. Since not only revolution actuation of an arm 1 but linear actuation is realized through those pulse actuation Exact positioning can also perform opening control, and since holding power acts on an arm 1 from piezoelectric-device a-e at the time of a halt, a special lock device can be made unnecessary. The configuration as [whole] an actuator because a single inch worm achieves the both sides of revolution actuation and linear actuation in addition to each piezoelectric-device a-e itself

being small and lightweight Compared with the case where the actuator of another ** is adopted in a revolution form and a linear form, small [whole] and lightweight-ization can be promoted further, and the effectiveness of the unloading to an arm 1 is also achieved in connection with this. Moreover, since a graphic display inch worm can be driven only by the single driver, it becomes possible to promote small [whole] and lightweight-ization further compared with the case where two kinds of drivers are needed. According to this example, the advantage which can set up the actuation rate of an inch worm easily by changing the period of the electrical-potential-difference impression to each piezoelectric-device a-e and the magnitude of an electrical potential difference is also acquired further again.

[0023] In addition, this invention is not limited only to the example mentioned above. For example, if an arm 1 is fixed in said example, a revolution and linear actuation can be made to perform to the inch worm itself. Moreover, what is necessary is just to perform same control to the piezoelectric devices a, c, and e which removed the migration child 5 and piezoelectric devices b and d, respectively, and remained, in constituting the inch worm which performs only revolution actuation. It can also constitute so that only revolution actuation may be made to perform with the same meaning.

furthermore -- although PZT was used as an actuator element in the above-mentioned example -- electromagnetism like functional devices, such as the other actuator element, for example, a shape memory alloy, and magnetostrictor, or a solenoid -- an actuator can also be used. Other configurations can also deform variously in the range which does not deviate from the meaning of this invention.

[0024]

[Effect of the Invention] As explained above, actuator elements, such as a piezoelectric device, are used for the inch worm concerning this invention. Since revolution actuation of an actuation lever is realized through those pulse actuation Exact positioning can also perform opening control and the lock device in which it is [making holding power act on an actuation lever from those actuator elements] easy at the time of a halt it, and it is special can be made unnecessary. Since the configuration as [whole] an actuator can also use a comparatively small and lightweight thing for each actuator element itself, small and lightweight-ization can be achieved compared with the conventional rotary actuator, and the unloading to an actuation lever can be achieved. The above effectiveness is the same also in a linear mold. Moreover, an above-mentioned revolution mold and an above-mentioned linear mold are merged, and when it constitutes so that actuation of both sides may be realized by the single inch worm, a stator, the actuator element for stators, and since a driver can also be shared further, the effectiveness which promotes further the effectiveness of the unloading to whole miniaturization and a whole actuation lever compared with the case where the actuator of another ** is constituted from a revolution form and a linear form is acquired.

[Translation done.]

again.
[0023] In addition, this invention is not limited only to the example mentioned above. For example, if an arm 1 is fixed in said example, a revolution and linear actuation can be made to perform to the inch worm itself. Moreover, what is necessary is just to perform same control to the piezoelectric devices a, c, and e which removed the migration child 5 and piezoelectric devices b and d, respectively, and remained, in constituting the inch worm which performs only revolution actuation. It can also constitute so that only revolution actuation may be made to perform with the same meaning. furthermore -- although PZT was used as an actuator element in the above-mentioned example -- electromagnetism like functional devices, such as the other actuator element, for example, a shape memory alloy, and magnetostrictor, or a solenoid -- an actuator can also be used. Other configurations can also deform variously in the range which does not deviate from the meaning of this invention.

[Translation done.]

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Category partition] The 4th partition of the 7th category
[Publication date] October 21, Heisei 6 (1994)

[Publication No.] Publication number 6-105568
[Date of Publication] April 15, Heisei 6 (1994)
[Annual volume number] Open patent official report 6-1056
[Application number] Japanese Patent Application No. 4-253246
[The 5th edition of International Patent Classification]

H02N	2/00	B 8525-5H
B23Q	5/28	8107-3C
B25J	19/00	A 8611-3F
G05D	3/00	G 9179-3H
H01L	41/09	

[FI]

H01L	41/08	U 9274-4M

[Procedure amendment]
[Filing Date] March 25, Heisei 6
[Procedure amendment 1]
[Document to be Amended] Description
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[Proposed Amendment]
[Claim(s)]
[Claim 1] The stator by which the hole which can expand and contract to the abbreviation radial was inserted in the actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., The actuator element for stators which carries out expanding-and-contracting actuation of the stator hole, and the rotator by which the hole which can expand and contract to the abbreviation radial was inserted in said actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., It comes to provide the actuator element for rotators which carries out expanding-and-contracting actuation of the rotator hole, and the actuator element for rotation which is prepared in the part which biased from said rotator hole, makes said stator a footing and energizes this rotator to the circumference of the axial center of an actuation lever. The inch worm characterized by

constituting so that revolution actuation of the actuation lever can be carried out at the shape of a pulse by driving said each actuator element, and repeating and giving minute rotation of the forward direction or hard flow to said stator to said rotator.
[Claim 2] The stator by which the hole which can expand and contract to the abbreviation radial was inserted in the actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., The actuator element for stators which carries out expanding-and-contracting actuation of the stator hole, and the rotator by which the hole which can expand and contract to the abbreviation radial was inserted in said actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., The actuator element for rotators which carries out expanding-and-contracting actuation of the rotator hole, and the actuator element for rotation which is prepared in the part which biased from said rotator hole, makes said stator a footing and energizes this rotator to the circumference of the axial center of an actuation lever, The migration larval tunnel by which the hole which can expand and contract to the abbreviation radial was inserted in said actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., Come to provide the actuator element for migration children which carries out expanding-and-contracting actuation of this migration larval tunnel, and the actuator element for migration which makes said stator a footing and energizes said migration child in the direction of an axial center of an actuation lever, and said each actuator element is driven. Revolution actuation of the actuation lever is carried out at the shape of a pulse by repeating and giving minute rotation of the forward direction or hard flow to said stator to said rotator. The inch worm characterized by constituting so that an actuation lever can be revolution-driven and attitude driven at the shape of a pulse by repeating and giving said migration child the minute rectilinear motion of the forward direction over said stator, or hard flow.
[Procedure amendment 2]
[Document to be Amended] Description
[Item(s) to be Amended] 0008
[Method of Amendment] Modification
[Proposed Amendment]
[0008] Moreover, the stator by which the hole which can expand and contract to the abbreviation radial was inserted in the actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. as a revolution and a linear mold, The actuator element for stators which carries out expanding-and-contracting actuation of the stator hole, and the rotator by which the hole which can expand and contract to the abbreviation radial was inserted in said actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., The actuator element for rotators which carries out expanding-and-contracting actuation of the rotator hole, and the actuator element for rotation which is prepared in the part which biased from said rotator hole, makes said stator a footing and energizes this rotator to the circumference of the axial center of an actuation lever, The migration larval tunnel by which the hole which can expand and contract to the abbreviation radial was inserted in said actuation lever by the hole of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., Come to provide the actuator element for migration children which carries out expanding-and-contracting actuation of this migration larval tunnel, and the actuator element for migration which makes said stator a footing and energizes said migration child in the direction of an axial center of an actuation lever, and said each actuator element is driven. Revolution actuation of the actuation lever is carried out at the shape of a pulse by repeating and giving minute rotation of the forward direction or hard flow to said stator to said rotator. By repeating and giving said migration child the minute rectilinear motion of the forward direction over said stator, or hard flow, it is characterized by constituting so that an actuation lever can be revolution-driven and attitude driven at the shape of a pulse.
[Procedure amendment 3]

[Document to be Amended] Description
[Item(s) to be Amended] 0010
[Method of Amendment] Modification
[Proposed Amendment]
[0010] On the other hand, among invention concerning claim 2, first, along with the 1 control mode of a control means, the operation only in connection with attitude actuation is divided into six steps of step 1 - step 6, and is explained. First, by the initial state, make the diameter of a stator hole reduce through the actuator element for stators, the diameter of a migration larval tunnel is made to reduce through the actuator element for migration children, and the actuator element for migration is degenerated. In this condition, an actuation lever is gripped to a stator and a migration child. Next, the diameter of a stator hole is made to expand through the actuator element for stators at step 1. By this, an actuation lever is opened from a stator and will be gripped only to a migration child. And the actuator element for migration is expanded at step 2, and advance energization of the migration child is carried out in the direction of an axial center. Thereby, a migration child moves forward and only a predetermined stroke also moves the actuation lever gripped to the migration child at this time only for the same stroke. Then, while making the diameter of a stator hole reduce through the actuator element for stators at step 3, the diameter of a migration larval tunnel is made to expand through the actuator element for migration children at step 4. Thereby, an actuation lever is opened from a migration child and grips only in a stator. From the condition, the actuator element for migration is degenerated at step 5, and retreat energization of the migration child is carried out in the direction of an axial center. Thereby, while the actuation lever had been held in the location, only a migration child moves only a predetermined stroke and it returns to the original location. And the diameter of a migration larval tunnel is made to reduce through the actuator element for migration children at step 6 finally, and it returns to the initial state stated to the beginning. By repeating the above actuation, advance actuation of the actuation lever will be carried out at the shape of a pulse. Moreover, if such control is carried out to reverse, retreat actuation of an actuation lever will be realized. And in this claim 2, since all the components of invention concerning said claim 1 are included, it becomes possible natural to also make only revolution actuation perform for an actuation lever.
[Procedure amendment 4]
[Document to be Amended] Description
[Item(s) to be Amended] 0024
[Method of Amendment] Modification
[Proposed Amendment]
[0024]
[Effect of the Invention] As explained above, actuator elements, such as a piezoelectric device, are used for the inch worm concerning this invention. Since revolution actuation of an actuation lever is realized through those pulse actuation Exact positioning can also perform opening control and the lock device in which it is [making holding power act on an actuation lever from those actuator elements] easy at the time of a halt it, and it is special can be made unnecessary. Since the configuration as [whole] an actuator can also use a comparatively small and lightweight thing for each actuator element itself, small and lightweight-ization can be achieved compared with the conventional rotary actuator, and the unloading to an actuation lever can be achieved. The above effectiveness is the same also in a revolution and a linear mold. When it constitutes so that revolution and linear actuation may be especially realized by the single inch worm, a stator, the actuator element for stators, and since a driver can also be shared further, the effectiveness which promotes further the effectiveness of the unloading to whole miniaturization and a whole actuation lever compared with the case where the actuator of another ** is constituted from a revolution form and a linear form is acquired.

[Translation done.]